# 2. POLLUTION IMPACTS FROM MARINAS AND BOATYARDS

Pollution impacts from marinas and boatyards depend on the types of activities that occur at the site and the way those activities are performed. Hull and engine maintenance and repair, fueling, and handling of sewage and solid waste can all harm the aquatic environment if mismanaged. Persistent toxic pollutants can create significant long-term environmental problems. Other less persistent pollutants can have immediate and severe impacts, but the damage to the environment can be eliminated once the pollutant is no longer discharged.

## PERSISTENT TOXIC POLLUTANTS

The two groups of toxic pollutants that accumulate in the sediments near marinas and boatyards are organic chemicals and heavy metals. Some organic chemicals occur naturally, but several hundred thousand have been developed for use in oils, paints, pesticides, cleaners, solvents, and other products. The organic compounds most commonly associated with activities at marinas and boatyards are hydrocarbons, solvents, and tributyltin (TBT). Hydrocarbons include persistent polynuclear (cyclic) aromatic hydrocarbons (PAHs) and are primarily found in oil, gasoline and exhaust from burning fuel. Components of gasoline, diesel fuel and kerosene, andsolvents can be less persistent and acutely toxic. TBT is a persistent chemical that was commonly used in antifouling paints on boats prior 1987 when it became regulated because of its toxicity to aquatic organisms. TBT is still in the sediments near many marinas and boatyards. Persistent organic chemicals eventually become harmless, but this process takes years or decades; during the interim, they can remain toxic.

Heavy metals are persistent elements such as lead, mercury, copper, nickel, cadmium, zinc, chromium, and arsenic. These metals are in paint particles, metal shavings, engine oils, bilge water, and runoff from maintenance and repair areas. Metals, such as chromated copper arsenate (CCA), are in wood preservatives commonly used in dock and pier construction. Metals generally do not break down into less harmful chemicals and tend to accumulate where they are released into the environment.

A number of studies have documented elevated levels of toxic contaminants in Maine's marine sediments. These accumulation levels are primarily attributed to human activity, including the operation of boatyards and marinas. Tests of sediment near wharves and docks show that PAHs and heavy metals frequently accumulate at elevated concentrations. TBT is elevated in the sediments of Casco Bay in areas around docks, anchorages, and boatyards.

### Toxicity

The toxicity of chemicals depends on how they are structured, how much is present, and how readily they can be absorbed and accumulated in the tissues of living organisms. Mercury, for example, is relatively nontoxic in some forms, but highly toxic in other forms. While essential for a healthy diet in low

concentrations, copper, nickel, and zinc can be lethal to humans and other animals in high doses.

In water, some toxic contaminants, such as gasoline, float to the surface where the young of many animals live during their most sensitive life stages. Others adhere to sediments and settle to the bottom where they can impact the aquatic environment. The highest levels of toxic pollutants usually accumulate in areas where sediments are deposited.

Hydrocarbons can be either harmful or benign. Some are not known to cause problems, while others may be toxic to aquatic organisms at very low concentrations. Many PAHs accumulate in tissues and can cause cancer, mutations and birth defects.

The use of TBT, an additive in paint, became popular because it keeps boat hulls relatively free of fouling organisms and does not harm aluminum hulls. Even in very low concentrations, TBT can accumulate in tissues or be lethal to plants and animals. Some molluscs are particularly sensitive. Federal and Maine laws prohibit the use or sale of antifouling paint containing TBT in most situations.

## Impacts from Persistent Toxic Pollutants

Persistent toxic pollutants have the potential to have a negative long-term impact on the aquatic environment. Toxic chemicals can also combine to produce a synergistic or “cocktail effect” that is more harmful than exposure to a single substance. Organisms vary widely in their uptake and retention of toxic contaminants. Some species exhibit reproductive, birth and developmental problems, organ damage or harmful impacts on the nervous, immune and endocrine systems, while other species seem to have no response.

Toxic contaminants are of particular concern because of the potential for bioaccumulation, bioconcentration and biomagnification in aquatic organisms.

> Bioaccumulation is the uptake and retention of pollutants from the environment by organisms.
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> Bioconcentration is the uptake and retention of pollutants directly from the water through tissues such as the gills, gut, or organ walls.
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> Biomagnification is the process whereby pollutants are passed from one animal to another resulting in higher levels of pollutants in organisms further up the food chain (e.g., birds, whales, and humans).

### Bottom-Dwelling Animals

Contaminants collect in sediments, so bottom-dwelling animals that live in mud habitats tend to accumulate pollutants. These bottom-dwelling (or benthic) animals play an important role as a source of food for larger animals such as fish, birds, and lobsters and crayfish. Many benthic animals feed by passing mud through their guts and extracting food. The toxic chemicals in the mud may accumulate in their tissues. When larger animals feed on them, the chemicals

may then accumulate in their tissues, and the pattern is repeated all the way up the food chain.

While thorough studies of toxic impacts on benthic life in Maine waters have not been undertaken, there is some evidence of damage in the polluted areas of Casco Bay. Animals that would be expected to live in this area are missing or impaired, potentially due to oil-related contaminants, heavy metals, combined sewer overflow discharges, sedimentary disturbances, or a combination of factors. In bottom samples taken in 1989, some hardy worms were present in much smaller numbers than expected, and mollusks, crustaceans, and other species were absent. Some of the worms collected had oil on their "feet" (parapodia), probably due to petroleum-related contaminants.

#### FISHERIES AND RECREATIONAL FISHING

Elevated levels of toxic contaminants in fish and crustaceans can inhibit growth and reproduction, disrupt the life processes of the young, change sex ratios, cause cancer or problems with the endocrine system, or even result in death. Toxic contaminants can inhibit natural immunities, making animals more susceptible to disease and attack by microorganisms. Fin rot in fish and shell degradation in lobsters are examples of this type of disease.

The livers of flounder caught near the Kennebec River in 1984 were found to have elevated levels of lead, copper, zinc, and PCBs. Experiments have shown that flounder are prone to develop tumors after eating worms contaminated by PAHs, and the presence of contaminants in their bodies causes them to generate additional toxic byproducts which further stimulate tumor growth.

#### WILDLIFE

Mammals and birds that feed on bottom-dwelling organisms or fish may absorb concentrated amounts of contaminants. Many of the tidal mudflats along Maine’s coast are important feeding areas for shorebirds, waterfowl, and wading birds. If the animals that they feed on in these flats are contaminated, the bird population may become impacted.

#### HUMAN HEALTH

When toxic contaminants pose an unacceptable health risk, the state toxicologist issues a consumption advisory. However, because testing has been limited, the absence of an advisory does not mean there is no problem. There are now health advisories which suggest people limit their consumption of lobster tomalley, striped bass, bluefish and freshwater fish because unhealthy levels of toxic pollutants have been documented in these animals.

#### ECONOMIC EFFECTS

Testing of sediment near wharves and docks prior to dredging has shown that PAHs, lead, mercury, nickel, copper and other heavy metals frequently accumulate at elevated levels. The economic consequences of allowing these sediments to become contaminated are great. If the sediments have to be dredged and do not pass the toxicity tests required by state and federal

agencies, they cannot be disposed of at sea, and disposing of them on land costs about ten times as much.

Another economic cost of toxic contamination is the potential impact on the viability of fishery stocks and the marketability of seafood. Maine fisheries depend on quality products and healthy populations of fish, lobsters and shellfish. If toxic pollutants impact growth and reproductive success, the productivity of the already struggling fisheries may be harmed. Also, seafood dealers stop buying fish or shellfish if they become aware of any potential health problems. In lakes and ponds, toxic contamination can impact fish stocks and the food quality of the recreational fishery.

### Sources

Toxic pollutants wash into harbors and bays from marinas or boatyards when it rains, during snowmelt, or during boat cleaning activities. Pollutants also are introduced directly into the water from activities such as fueling and running boat engines.

Heavy metals in Maine's aquatic environment are the result of contemporary or historical discharges from vehicles and industry, leaching from rocks and minerals, deposition from polluted air, as well as from activities at marinas and boatyards. Antifouling paints are designed to be toxic to aquatic organisms and are a source of heavy metals. Various maintenance and repair activities may also add these contaminants to the aquatic environment.

PAHs and other hydrocarbons in Maine's waters come from drippings and debris from vehicles and their exhausts; smoke from industries and residences; stormwater discharges; old industrial sites and dumps; air pollutants from the eastern seaboard and the midwest; and businesses that use and handle oil, including marinas and boatyards. During fueling, hydrocarbons in dripping gasoline or diesel fuel may be discharged into the water, onto the dock, or onto adjacent land areas. Accidental spills result in the discharge of hydrocarbons directly to the water or indirectly through surface runoff or from groundwater. Roughly 70 spills, averaging 20 gallons each, are reported each year in Maine. Drippings and drainage from boat engine maintenance and repair activities, or simply from running boat engines, may contain fuels, oil, or other oil-based lubricants. If not properly contained, these substances may enter the water directly or be transported by surface runoff or groundwater seepage. Finally, runoff from parking areas, boat ramps, and other impervious areas may contribute hydrocarbons to the aquatic environment.

## OTHER POLLUTANTS ASSOCIATED WITH MARINAS AND BOATYARDS

Less persistent pollutants may have immediate and potentially severe impacts on the aquatic environment, but the damage to the environment can be eliminated once the pollutant discharge has ceased. These pollutants include:

**Solvents:** Solvents are used in engine maintenance and repair, boat painting, and cleaning. Solvents such as tetrachloroethylene, tetrachloroethane, trichloroethylene, trichloroethane, and methylene chloride are used as

degreasing agents and in varnishes, paint removers, and lacquers. Many solvents are known carcinogens.

**Antifreeze:** Antifreeze that contains ethylene glycol or propylene glycol is toxic to aquatic organisms. Such antifreezes are used as engine coolants and to prevent freezing during winter storage. Both dry storage and engine maintenance involve the use, storage, and disposal of these materials. Improper use, storage, or disposal may result in the release of these compounds to the aquatic environment via surface runoff or groundwater transport. Antifreeze is occasionally dumped directly into lakes and coastal waters, particularly in the spring when boats are launched after winter storage.

**Acids/Alkalis:** The primary sources of acids and alkalis from marinas are batteries and compounds used for cleaning boats. Battery acid is extremely corrosive and often contains high concentrations of heavy metals (e.g., lead). Spilled battery acid may be transported to the aquatic environment via surface runoff or groundwater transport. Cleaning compounds and detergents often contain strong acids or lye. These acids and alkalis may enter surface waters via direct discharge if cleaning takes place over the water, or via surface runoff or groundwater transport from upland work areas. Acids may make heavy metals and other toxics soluble, impacting aquatic organisms. In a localized area, acids may also lower the pH of water, particularly fresh water, harming or killing aquatic life.

**Sediments:** Sediments may enter the aquatic environment during construction, boat scraping and sanding, and by stormwater runoff. Operating boats in shallow waters can scour the bottom and resuspend bottom sediment, as well as cut off or uproot aquatic plants. Sediments are also stirred up during dredging operations. Sediments may affect the aquatic environment by: 1) smothering bottom-dwelling plants and animals; 2) increasing turbidity, which may reduce the amount of available light that plants and phytoplankton need to grow, as well as affect the ability of animals to find food; 3) clogging fish gills; 4) increasing sediment oxygen demand, resulting in the depletion of dissolved oxygen and 5) attaching to contaminants, such as heavy metals and hydrocarbons.

**Chlorine and formaldehyde:** Chlorine and formaldehyde are used to sanitize human wastes from boats. These chemicals can be very toxic to aquatic organisms and can greatly impact plants and animals that are directly exposed. Chlorine and formaldehyde are relatively non-persistent in the environment and do not accumulate in sediments. Some species of spawning fish, such as salmon, trout, shad, and alewives, can detect toxic pollutants such as chlorine and avoid contaminated rivers, but this rerouting can disrupt their migration.

**Surfactants:** Surfactants are present in most detergents and other cleaning agents and occur in a wide variety of chemical formulations of both natural and synthetic origin. Some surfactants, such as alkyl benzene sulfonate (ABS), may be acutely toxic to aquatic organisms. In aquatic environments, surfactants may form a surface film and reduce oxygen transfer at the water surface. In

addition, surfactants have been documented to exhibit synergistic effects with other substances. Indirectly, surfactants may alter the hydraulic characteristics of soils, thus affecting the movement of contaminants through soils and into groundwater. Surfactants and detergents may also cause foam on the waters, which is aesthetically displeasing.

**Nutrients:** Nutrients, particularly nitrogen and phosphorus, are essential to aquatic plant growth. However, in elevated concentrations, they stimulate nuisance plant growth either in the form of algae blooms, or excessive growth of weed-like aquatic plants. When this excessive plant growth dies and decays, dissolved oxygen concentrations may become depleted and kill fish and other aquatic animals. Algae blooms can reduce light penetration and harm beneficial aquatic plants such as eelgrass. Also, excessive growth of tiny plants attached to the blades of aquatic plants can harm the growth of the larger plant. Weed-like plants tend to out-compete the normal aquatic plants and may smother animals. In marine waters, excess nitrogen tends to stimulate nuisance plant growth; in freshwater, phosphorus tends to be the nutrient that stimulates growth.

Marina and boatyard activities that may add excessive nutrients to the aquatic environment include sanitary wastewater disposal, dredging, fertilizing lawns, soil disturbance, and boat cleaning with compounds that contain nutrients.

**Pathogens:** The principal source of pathogens, such as bacteria and viruses, is sanitary wastewater disposal. Discharge of untreated sanitary wastes from boats is prohibited in Maine's inland waters and in marine waters within three miles of the coast. However, illegal discharges by boaters do occur. Malfunctioning onshore septic or overboard treatment systems, spills from sanitary pumpout facilities, partially treated sanitary discharges, pet waste, and stormwater runoff are all sources of pathogens. Whatever the source, these pollutants can cause clamflat and swimming area closures and disease or infection in people who come in contact with water.

**Floatables/Plastics:** The primary sources of floatable and plastic materials in the water are from marina or boatyard construction and solid wastes generated at the site. Most waste found in aquatic environments has been discarded directly into the water, although some is blown in or washed in during storms. Besides making waters and beaches unattractive, animals may become entangled in the debris or mistake bits of plastic for food.

## Reducing Toxic Pollution

Steps that have already been taken to reduce the amount of contamination entering Maine's waters include:

- stricter requirements for industrial and municipal discharge permits and pre-treatment programs;
- the reduction of combined sewer overflows;
- better oil-spill prevention and response;
- the cleanup of many hazardous waste sites;
- the discontinued use of shore-side dumps;

- the elimination of leaded gasoline;
- increased awareness among citizens and boaters regarding safe disposal of toxic materials;
- collection programs for household hazardous wastes; and
- the use of best management practices in road construction, development, farming, forestry, and marinas, and boatyards.

To continue reducing levels of pollution in Maine waters, more attention must now be focused on nonpoint sources of pollution such as marinas and boatyards. The following chapters describe the things that marina and boatyard operators can do to protect the resource they depend on. Once these measures are taken, pollution levels will be reduced and the ecosystem will eventually cleanse itself: persistent pollutants will be diluted when covered and mixed with new, cleaner sediments and some will break down chemically. But the ecosystem cannot recover without a concerted effort on the part of all who enjoy and use Maine's waters to stop the small but numerous discharges of pollution.